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STRATEGIC MINERALS INVESTIGATIONS

PROGRESS REPORT ON EXPLORATION OF TIN DEPOSITS

BY

MINING DIVISION

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

STRATEGIC MINERALS INVESTIGATION

PROGRESS REPORT ON EXPLORATION OF TIN DEPOSITS[1]

By the Mining Division

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INTRODUCTION

In connection with the strategic minerals investigations of the Bureau of Mines and the Geological Survey under authority of the Strategic Materials Act (Public 117, 76th Cong., 1st sess.) a study is being made of tin deposits in the United States in an effort to improve the situation with respect to domestic supplies. These studies include sampling and exploration of some of the larger deposits with the objective of establishing emergency reserves, if possible to do so. Two exploration projects have been completed, and the over-all results obtained are set forth in this progress report.

RESOURCES

Tin was first discovered on this continent in 1840 in the Temescal Mountains of what is now southern California. In the ensuing century, occurrences of tin have been reported in no less than 17 States and Alaska. Although most of these are of scientific interest only, tin-bearing veins and placers in California, Alabama, North and South Carolina, Virginia, South Dakota, Wyoming, Texas, New Mexico, and Alaska have been extensively explored, and large sums of money have been expended in recurring attempts to exploit them.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7154".

PRODUCTION AND CONSUMPTION

Recorded production of tin in the United States and Alaska during the 80 years since the first output of specimen tin from California in 1860 totaled only 1,816 long tons, of which 82 percent came from the Alaskan placers.

Prices during this 80-year period ranged from a low of 12-5/8 cents a pound in 1896 to a high of $1.10 in 1918. The maximum production in any one year was 168.4 long tons in 1937, when 73,000 tons of primary and 17,000 tons of secondary tin were consumed by American industry. Thus in the best year of record, production from all sources amounted to less than two-tenths of 1 percent of national requirements. It is probable that, except for tin saved as a byproduct of gold-mining operations and the small output of a few individual placer miners washing creek gravels by hand, every pound of tin mined in the continental United States has been produced at a loss. Exclusive of Alaska, expenditures variously estimated at $5,000,000 to $17,000,000 have resulted in the production of not more than $350,000 worth of tin. The price of $1.10 a pound in 1918 was not high enough to stimulate new activity to any extent or to permit profitable operation of the mines.

ESSENTIAL USES AND STRATEGIC IMPORTANCE

Tin plate, solder, and bearing metals use around 80 percent of the tin consumed and require 50,000 to 70,000 tons annually. These materials or their equivalent are vital elements in the national defense program.

The chief use for tin plate is in food containers. For some foods other materials can be used, generally at higher cost and a sacrifice of convenience in packing and handling. For others no satisfactory substitute has been found. Furthermore, the food-packing industry is equipped to use tin containers, and the procurement of new machines required to handle other kinds of containers would be undesirable and difficult at a time when every effort is being made to expand defense industries.

Substitutes for many applications of solder and bronze have been developed, likewise for the most part more costly and in some instances less suitable than the tin-bearing materials customarily employed. It is believed that the maximum substitution possible without too great sacrifice of industrial efficiency would not exceed 25 to 30 percent of normal requirements.

Tin ranks high among the strategic metals because, although it is essential to the national economy, domestic production never has approached even 1 percent of current needs and known resources are too meager to provide any material increase in output under any conditions.

EXPLORATION OF DOMESTIC DEPOSITS

Notwithstanding the discouraging history of production a study of tin deposits was included in the strategic minerals investigations undertaken jointly by the Bureau of Mines and the Geological Survey beginning in 1939. Some of the more promising occurrences were chosen for exploration to determine the extent and grade of reserves and the quantity and cost of tin that could be produced from them in an emergency.

The Bureau's first field work on tin was directed toward determination of reserves at two localities where wide distribution of cassiterite offered some possibility of developing large tonnages of material containing enough tin to constitute an emergency supply. Preliminary examinations by engineers of the Bureau and geologists of the Geological Survey at Tinton, S. Dak., and in the Taylor Creek district of Catron and Sierra Counties, N. Mex., were followed by exploration projects. Extensive trenching, test pitting, and core drilling were undertaken to test lode deposits at Tinton and lodes and placers in New Mexico. The reserves developed were disappointing both as to quantity and grade, and the indicated cost of recovery is high.

CONCLUSIONS

These early results tend to strengthen the conviction that no appreciable part of the tin required by American industry can be supplied from known domestic sources, regardless of how great the stringency or how high the price. Stock-piling, the discovery of new deposits, and the development of substitutes appear to be the only alternatives for insurance against acute shortage should access to overseas supplies be denied.

Details of results at the two completed projects follow.

Results of Exploration at Tinton, S. Dak.

Tin mines and placers in the Black Hills have produced about 365,000 pounds of tin valued at approximately $98,000 since the first discovery of lode tin at the Etta mine in the Southern Hills, according to estimates and production figures compiled by E. D. Gardner and reported in Bureau of Mines Information Circular 7069, Tin Deposits of the Black Hills, South Dakota. Between 7 and 15 million dollars are said to have been expended on the various properties for promotion expenses, the acquisition of claims, development, and equipment.

Nearly one-third of the total output of the district is credited to the Rough & Ready mine at Tinton in the Northern Hills. During 3 years' operation this mine produced 104,987 pounds of tin valued at $27,371.15. The concentrates, averaging around 50 percent Sn, were recovered from 14,330 tons of ore that contained 10.995 pounds of tin per ton.

Following a preliminary survey of the area in connection with the investigation of noncommercial domestic sources of strategic minerals from which supplies might be drawn in an emergency, the Bureau of Mines in cooperation with the Geological Survey undertook in 1939 to sample and explore the Rough & Ready mine to determine the tonnage and grade of reserves and to seek extensions of exposed ore bodies. Work was started in August 1939 and completed March 1, 1940.

Existing surface and underground workings were sampled and mapped, tin-bearing pegmatite dikes were explored by extending drifts a total of 229 feet, and downward extensions were sought by 4,000 feet of core drilling in 11 holes from surface and underground stations. Drill cores were logged and

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geologic sections prepared by the Geological Survey; 953 core, sludge, and channel samples were taken and shipped to the Reno laboratory of the Bureau of Mines for analysis.

Reserves calculated from data provided by these operations which extended to a maximum depth of 180 feet totaled 800,000 pounds of tin in rock containing 1 pound or more per ton and averaging 4.32 pounds. The operating cost of producing tin from rock of this average grade mined at the rate of 150 tons per day would be around $2.00 per pound of tin recovered.

About half the total reserve of tin is contained in 68,000 tons of material above the 135-foot level averaging 6.33 pounds per ton, from which it is estimated that 150 tons of tin in concentrates could be produced in 18 months to 2 years at an operating cost of around $1.15 per pound of tin recovered. The capacity of the existing mill is said to be 150 tons of ore per day, and recovery of 70 percent of the tin in the ore is reported. The foregoing estimates are based upon this performance.

Results of Exploration in Taylor Creek District, N. Mex.

A preliminary study of widespread occurrences of tin in an area comprising nine townships in Catron and Sierra Counties, N. Mex., suggested the possible existence of large reserves of low-grade material from which a considerable quantity of tin might be produced in an emergency at a cost that would not be prohibitive.

Stream tin was first discovered in the Taylor Creek district in 1918, and tracing the float to its source soon led to the discovery of tin-bearing veins in zones of altered rhyolite. Twelve deposits consisting of both lode and placer have been found and covered by mining locations. Other occurrences have been reported at nearby localities.

The deposits were examined and reported on by the Federal Geological Survey[2] in 1920. In 1939 a preliminary examination was made by the Bureau of Mines and an exploration project recommended, the object of which was to determine the tonnage and grade of reserves and the quantity and cost of tin that might be produced from them.

Field work was begun in August and concluded in December 1939. Thorough sampling of both lode and placer deposits was undertaken. To obtain bulk samples of lode deposits two crosscuts, a raise, and three shafts were excavated. Outcrops were trenched and channel-sampled, and placers were sampled by test pitting and trenching. A total of 1,116 samples was shipped to the Metallurgical Division of the Bureau of Mines at Reno for analysis and metallurgical tests.

The results of these tests indicated, with respect to the lode deposits, that no vein or combination of veins would support selective mining. An

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[2] Hill, J. M., The Taylor Creek Tin Deposits, New Mexico; Geol. Survey Bull. 725(g), 1922, pp. 347-359.

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area of about 5 acres of altered rhyolite at Nugget Gulch and about 14 acres at Taylor Creek could be mined by a bulk method. These areas are estimated to contain a probable quantity of 11,176,395 tons and a possible additional tonnage of 30,262,000 tons of tin-bearing rock averaging 0.02 percent Sn or 0.4 pound of tin per short ton. Thus the total amount of tin contained in this reserve would be 8,363 tons.

The cassiterite is closely associated with hematite and is not readily separated from it. Hence, concentrates are low grade and high in iron. Recoveries are likely to be low, as indicated by a series of tests of material averaging 0.03 percent or 0.6 pound Sn per ton. Concentrates obtained in these tests contained 1 to 16 pounds of tin per ton, and recoveries ranged from 10 to 47 percent. It is doubtful whether a concentrate suitable for smelting can be made from this material with a satisfactory recovery of tin. If it is assumed that a method might be developed to produce a concentrate containing 40 percent tin and 30 percent iron with a recovery of 80 percent of the tin in the ore, the estimated cost of mining, milling, freight, and smelting would total $5.20 per pound of recoverable tin.

The placer deposits were found to be low-grade and of small extent. Minable gravel at three localities aggregates 347,760 cubic yards containing 108,580 pounds of tin, or three-tenths pound per cubic yard. It was concluded that any possible production from this source would be unimportant and uneconomic.